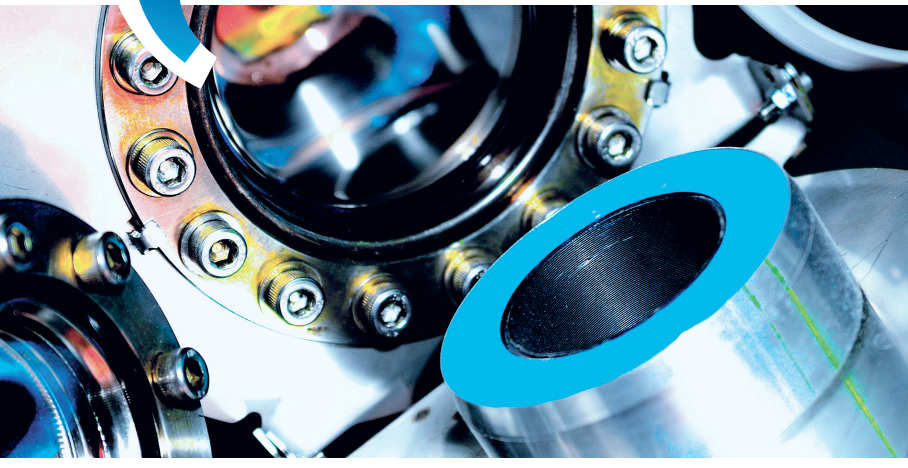
HZB Helmholtz Zentrum Berlin



HELMHOLTZ RESEARCH FUNDING

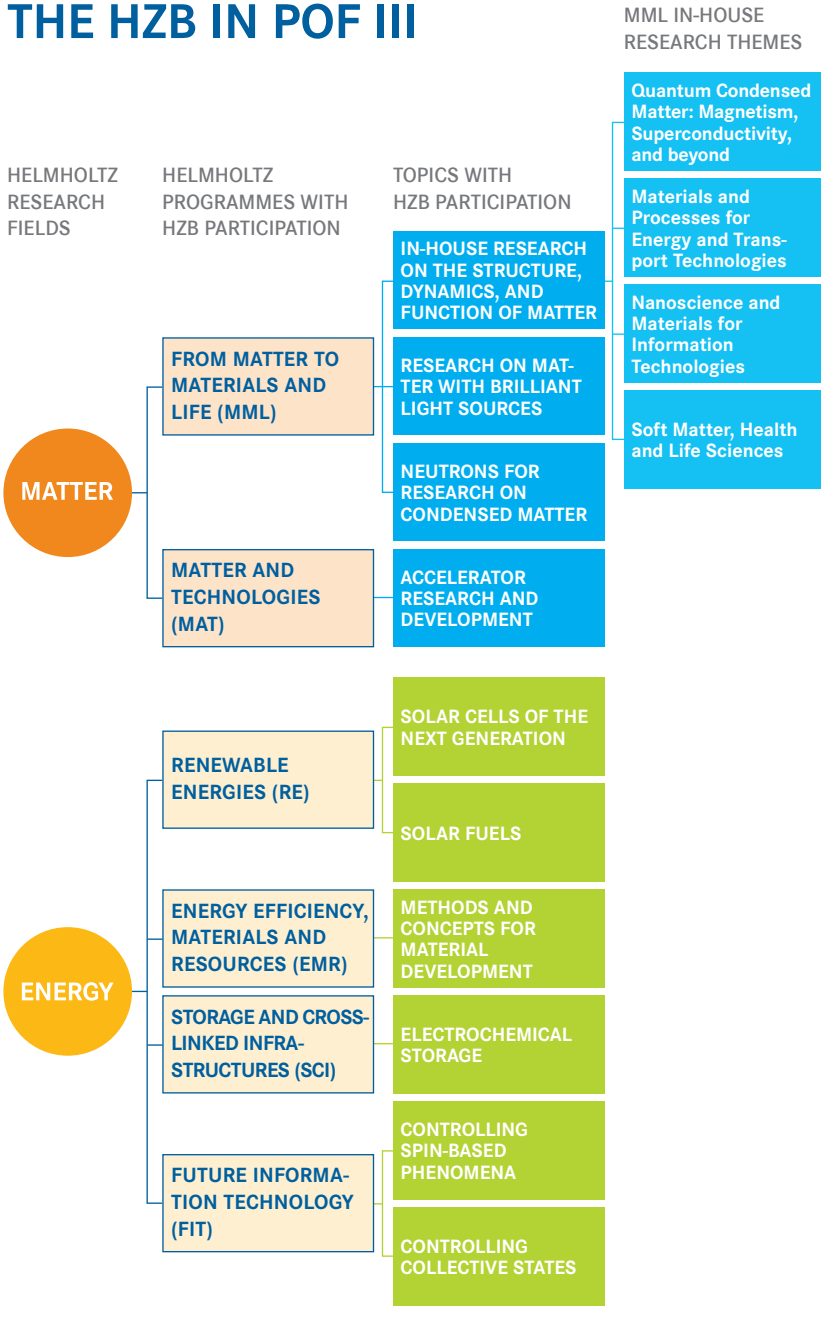
HZB IN POF III

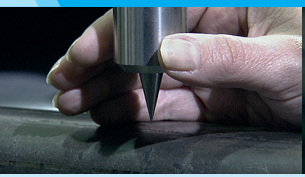
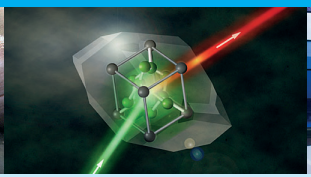
What's Programme-Oriented Funding (POF) about?

Since 2001, the Helmholtz Association centres have united their research and development work into various programmes that are all part of the six main Helmholtz research fields. These programmes form the basis for both funding and evaluation. The programmes' scientific scope is organised into smaller units called topics. Every five years, with the start of a new funding period, the research programmes are adjusted or new programmes set up. The programmes and topics are evaluated by a team of international experts. During the POF III funding period, the Helmholtz-Zentrum Berlin will be involved in a total of six programmes as part of the Helmholtz research fields "Energy" and "Matter."

Funding period POF III 2015-2019 – what's new? As performance category II (LK II) facilities, BESSY II and BER II are subject to a separate funding and evaluation process to ensure their operation is never compromised by rising costs. In performance category I (LK I), each topic is evaluated on an individual basis. The real competition is between different topics and programmes and is intended to promote collaboration between participating centres. In POF III, Helmholtz centres will for the first time ever be able to identify strategic partners that contribute their own resources in the form of associated programme involvement.

THE HZB IN POF III




HELMHOLTZ PROGRAMMES / HELMHOLTZ-PROGRAMME:

FROM MATTER TO MATERIALS AND LIFE (MML) / VON MATERIE ZU MATERIALIEN UND LEBEN (MML)

TOPICS:

- **In-house Research on Structure, Dynamics and Function of Matter at Large-Scale Facilities /** Eigenforschung zur Struktur, Dynamik und Funktion von Materie an Großgeräten

FACILITY TOPICS:

- **Research on Matter with Brilliant Light Sources /** Forschung über Materie mit brillanten Lichtquellen
- **Neutrons for Research on Condensed Matter /** Neutronen für die Erforschung kondensierter Materie

MATTER AND TECHNOLOGIES (MaT) / MATERIE UND TECHNOLOGIE (MuT)

TOPIC:

- **Accelerator Research and Development /** Beschleunigerforschung und -entwicklung

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM

FROM MATTER TO MATERIALS AND LIFE (MML)

The Helmholtz Association operates unique large-scale facilities for material research. These facilities are the foundation for research that is being done as part of the MML programme. They are available to academic users from universities and industry, although the Helmholtz centres themselves are also using them for their own in-house research. This is why the programme includes a topic for in-house research, falling under LK I, as well as four other topics that together make up LK II, focussing on the operation and continued development of large-scale facilities. HZB participates in two LK II topics: “Neutrons for Research on Condensed Matter” and “Research on Matter with Brilliant Light Sources” as well as contributing to “In-house Research on Structure, Dynamics, and Function of Matter at large-scale Facilities” (LK I). The latter topic is further subdivided into four separate research themes that are also subject to competitive evaluation as part of the POF process.

PARTICIPATING CENTRES: DESY / GSI / HZB / HZDR / HZG / FZJ / KIT
SPOKESPERSON: Prof. Dr. Andreas Schreyer, HZG

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM

MATTER AND TECHNOLOGIES (MaT)

In the MaT programme, the Helmholtz Association is pooling its expertise in the areas of accelerator and detector development and laying the foundation for continuing and new development of large-scale equipment, while constantly pushing the envelope on innovation in different areas of application. HZB's focus is on accelerator technology and on developing new designs that can be used to accelerate electrons so they radiate electromagnetically, producing high-intensity light. This light can be extracted in the form of short or long pulses. In addition, HZB experts are hard at work building a prototype energy recovery linear accelerator (B*ERL*inPro) to produce a brilliant electron beam for various applications, including light sources and electron coolers.

PARTICIPATING CENTRES: DESY / FZJ / GSI / HZB / HZDR / KIT
SPOKESPERSON: Dr. Ties Behnke, DESY

HELMHOLTZ PROGRAMME: FROM MATTER TO MATERIALS AND LIFE (MML)

TOPIC:

IN-HOUSE RESEARCH ON STRUCTURE, DYNAMICS AND FUNCTION OF MATTER AT LARGE-SCALE FACILITIES / LKI

For this research area, the centres are pooling their in-house research that they are conducting with the aid of their large-scale facilities. The HZB is involved in the research areas of “Quantum Condensed Matter: Magnetism, Superconductivity, and beyond”, “Materials and Processes for Energy and Transport Technologies”, “Nanoscience and Materials for Information Technologies”, as well as “Soft Matter, Health and Life Sciences.” Using the measuring instruments that are available at the BER II neutron source and the BESSY II synchrotron source, complex processes can be observed at high temporal and spatial resolutions even under extreme conditions of pressure, temperature, and magnetic fields.

RESEARCH GOAL

To identify new classes of materials and develop a fundamental understanding of how they function - especially with respect to resource and energy-efficient technologies; to optimise measuring instruments and methods.

EXPERTISE

Microscopy, small-angle scattering (SAS), spectroscopy, colloidal structure synthesis, theory and simulation of complex structures.

RESEARCH FACILITY

- BER II
- BESSY II

Helmholtz Partners
DESY / FZJ / GSI / HZDR / HZG / KIT / VI “New states of matter and their excitations” / VI “Dynamic Pathways in Multidimensional Landscapes” / VI “Multifunctional Biomaterials for Medicine”

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HELMHOLTZ PROGRAMME: FROM MATTER TO MATERIALS AND LIFE (MML)

FACILITY TOPIC:

RESEARCH ON MATTER WITH BRILLIANT LIGHT SOURCES / LK II

BESSY II produces brilliant synchrotron light and is optimised for spectral ranges from vacuum UV to soft X-rays. The instruments permit experiments at high-resolutions: spatially to 10 nanometers, temporally to 100 femtoseconds, and in the spectral range down to milli electron volts. All instruments and the accelerator systems are continually upgraded. Energy research has become an important focus.

INSTRUMENTS

Currently 39 instruments are in operation, including FEMTOSPEX, 1^2/1^3 ARPES, X-ray microscopy, RICXS, MX and EDDI beamline, S-PEEM, ARTOF in pseudo single bunch, THz-EPR.

USER OPERATIONS

Each year, approx. 5,200 hours of user operations, 2,500 measuring guests, and 400 publications. Helmholtz programmes using BESSY II: MML, EMR, FIT, as well as for various cross-programme activities.

FUTURE

By 2015, EMIL will start operation; with BESSY^{VSR}, a concept for a “Variable Pulse length Storage Ring” will be developed and B*ERL*inPro a feasibility study for “Energy Recovery Linac” will give an outlook for a successor light source for BESSY III (2020).

Strategic Partners
BAM / Budker-Institute for Nuklearphysics / MPG / PTB / Russian-German Lab / Universities
HZB Organisational Units
F-ISFM / F-AME / F-NFF / F-GFN / F-GUD / M-ICMM / M-AMD / G-ARSN / G-AUND / G-ISRR / G-IA / G-ISRF / G-INT / NP-ACD / NP-ABS / NP-AUN / NP-ASE / NP-HII / NP-AUP / NP-AED / NP-ASN

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HELMHOLTZ PROGRAMME: FROM MATTER TO MATERIALS AND LIFE (MML)

FACILITY TOPIC:

NEUTRONS FOR RESEARCH ON CONDENSED MATTER / LK II

The neutron source BER II delivers both cold and thermic neutrons for use in research. Laboratory infrastructure, highly specialised sample environments, and expert scientific support are available to both individual researchers and a global user community. In-house research at the HZB focusses increasingly on materials for energy conversion or future information technologies.

INSTRUMENTS

After an evaluation in 2013, BER II will offer the best and internationally most competitive instruments to the user community, including EXED/HFM and NEAT II (beginning in 2015), powerful diffractometers, as well as instruments for high-resolution neutron spectroscopy.

USER OPERATIONS

Each year, approx. 4,000 hours of user operations, 300 measuring guests, and 100 publications. BER II is used by the Helmholtz programmes MML, SCI, EMR, FIT, as well as for various cross-programme activities.

FUTURE

BER II will be used scientifically through January 1, 2020. Beginning in 2015, EXED, the new 23-30 tesla high-field magnet, and NEAT II, the new time-of-flight spectrometer, will start operations.

Strategic Partners
Beuth Hochschule / Universities

HZB Organisational Units
F-IAM / F-ISFM / F-AME / M-ICMM / M-AKR / G-ARSN / G-GTOMO / NP-ACD / NP-ABR / NP-HI / NP-AUN / NP-ASE / NP-AED

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HELMHOLTZ PROGRAMME: MATTER AND TECHNOLOGIES (MaT)

TOPIC:

ACCELERATOR RESEARCH AND DEVELOPMENT / LKI

HZB research focusses on the radiation dynamics of new accelerator designs, their necessary analysis, and new radiofrequency cavities. Using these cavities from superconducting SRF-systems, it is possible to generate extremely short high-intensity light pulses. These are needed for the future BESSY^{VSR} and B*ERL*inPro projects and permit the generation of an almost arbitrary sequence of both short and long pulses – a variable fill pattern. HZB experts are also developing designs for generating ultra-short electron bunches that can be used to produce light pulses in the pico- and femtosecond range.

RESEARCH GOAL

Development of new, more effective accelerator technologies and designs: storage rings, superconducting cavities, and short light pulses for greater temporal resolution

EXPERTISE

Test facility for superconducting cavities HoBiCaT

RESEARCH FACILITY

- **BESSY II:** undulator systems and instrumentation
- **B*ERL*inPro:** Energy Recovery Linac prototype (beginning in 2017)

Helmholtz Partners
DESY / FZJ / GSI / HZDR / KIT

Strategic Partners
Cornell University / Humboldt-Universität / TU Dortmund / Universität Mainz / Universität Rostock

HZB Organisational Units
G-IA / G-ISRF / G-NSIMU

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CONTACT:

TOPIC:
IN-HOUSE RESEARCH ON STRUCTURE, DYNAMICS AND FUNCTION OF MATTER AT LARGE-SCALE FACILITIES

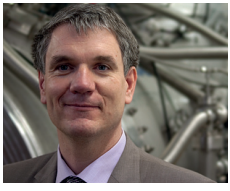
Topic speaker:
Prof. Dr. Matthias Ballauff

FACILITY TOPIC:
RESEARCH ON MATTER WITH BRILLIANT LIGHT SOURCES

HZB-coordinator:
Prof. Dr. Alexander Föhlisch

FACILITY TOPIC:
NEUTRONS FOR RESEARCH ON CONDENSED MATTER

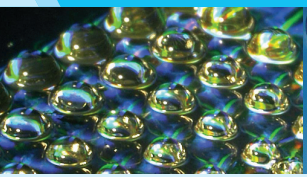
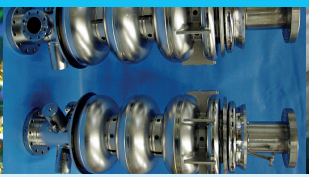
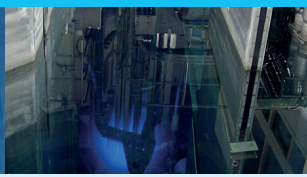
Deputy topic speaker:
Dr. Klaus Habicht



TOPIC:
ACCELERATOR RESEARCH AND DEVELOPMENT

Topic speaker:
Prof. Dr. Andreas Jankowiak

Additional HZB-coordinator:
Prof. Dr. Jens Knobloch

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM:

FROM MATTER TO MATERIALS AND LIFE (MML) / VON MATERIE ZU MATERIALIEN UND LEBEN (MML)

TOPIC:

In-house Research on Structure, Dynamics and Function of Matter at Large-Scale Facilities /
Eigenforschung zur Struktur, Dynamik und Funktion von Materie an Großgeräten

RESEARCH THEMES / FORSCHUNGSTHEMEN:

- **Quantum Condensed Matter: Magnetism, Superconductivity, and beyond /**
  Kondensierte Quantenmaterie: Magnetismus, Supraleitung und darüber hinaus
- **Materials and Processes for Energy and Transport Technologies /**
  Materialien und Prozesse für Energie- und Verkehrstechnologien
- **Nanoscience and Materials for Information Technologies /**
  Nanowissenschaften und Materialien für die Informationstechnologie
- **Soft Matter, Health and Life Sciences /**
  Weiche Materie, Gesundheit und Lebenswissenschaften

TOPIC: IN-HOUSE RESEARCH ON STRUCTURE, DYNAMICS AND FUNCTION OF MATTER / MML / LKI

RESEARCH THEME:

QUANTUM CONDENSED MATTER: MAGNETISM, SUPERCONDUCTIVITY, AND BEYOND

Some of the spectacular properties of solids like complex magnetic order or superconductivity are due to electronic correlations. They are characterised by various competing interactions, for example in low-dimensional materials and multiferroic nanostructures. These classes of materials may be relevant for future technologies like spintronics.

RESEARCH GOAL

To characterise new physical properties on every relevant time, length, and energy scale and to continuously develop instruments and methods needed for this characterisation.

EXPERTISE

Use of polarised neutrons and photons; analysis of samples under extreme conditions.

RESEARCH FACILITY

- **BER II:** neutron scattering, high field magnet >25 T with instrument EXED, 4D time-of-flight spectrometer NEAT
- **BESSY II:** X-ray spectroscopy and scattering (ARPES, RIXS, VEKMAG), FEMTOSPEX slicing facility

Helmholtz Partners
DESY / FZJ / HZG / HZDR / VI "New states of matter and their excitations" / VI "Dynamic Pathways in Multidimensional Landscapes"

HZB Organisational Units
F-GFN / M-ICMM / G-ISRR

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TOPIC: IN-HOUSE RESEARCH ON STRUCTURE, DYNAMICS AND FUNCTION OF MATTER / MML / LKI

RESEARCH THEME:

MATERIALS AND PROCESSES FOR ENERGY AND TRANSPORT TECHNOLOGIES

CPA: Materials Research – Energy Supply

This research subject is closely connected with other programmes in the research areas of "Matter" and of "Energy" via its interdisciplinary activities. HZB activities are focussed on chemical and optically induced processes that are of fundamental importance for catalysts as well as for energy storage and conversion. Of particular interest are the dynamics of charge carriers and the question of how chemical bonds are formed and severed – which are processes that take place very quickly. The instruments at the large-scale facilities will be further adapted in order to observe these processes and trace structures that span only a few nanometres.

RESEARCH GOAL

Acquire fundamental insights into high-performance materials for solar energy and photo- and electrochemical processes as well as into classes of materials for energy conversion and storage.

EXPERTISE

High-resolution spectroscopy

RESEARCH FACILITY

- **BESSY II:** Photoelectron spectroscopy, RIXS, EXAFS/XANES, HHG

Helmholtz Partners
DESY / FZJ / HZDR / HZG / KIT / VI "Dynamic Pathways in Multidimensional Landscapes"

HZB Organisational Units
F-GUD / G-ISRR

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TOPIC: IN-HOUSE RESEARCH ON STRUCTURE, DYNAMICS AND FUNCTION OF MATTER / MML / LKI

RESEARCH THEME:

NANOSCIENCE AND MATERIALS FOR INFORMATION TECHNOLOGIES

In the field of nanoscience, the centres address the extraordinary physical and chemical properties that differentiate nanostructures from micro- and macrostructures. Scientists are investigating fundamental properties and processes of nanostructures down to the sub-nano realm by means of cutting-edge spatial and temporal resolution techniques. These have immediate importance for information technology.
HZB scientists are developing nano-optical materials, photonic crystalline fibres, and 3-D XUV optical systems consisting of nanostructures. These materials are being adapted so as to function with unprecedented precision.

RESEARCH GOAL

To improve instrument resolutions and extend physical limits in the field of imaging methods, spectroscopy and scattering methods. Ultra-fast dynamics will also be included in in-situ studies.

EXPERTISE

XUV optics, metrology, nanotechnology

RESEARCH FACILITY

- **BESSY II:** Optic, MySpot, nanolaboratory

Helmholtz Partners
HZDR / DESY / KIT / HZB / GSI

HZB Organisational Unit
G-INT

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TOPIC: IN-HOUSE RESEARCH ON STRUCTURE, DYNAMICS AND FUNCTION OF MATTER / MML / LKI

RESEARCH THEME:

SOFT MATTER, HEALTH AND LIFE SCIENCES

CPA: Stuctural Biology / CPI: Medicine and Technololy – Adaptive Systems

The focus is on polymers, organic nanostructures, and biomolecules that perform multiple complex functions in solution, thin films, glasses, and biological systems. Parameters that influence these functions are investigated. HZB groups make polymer films, complex fluids, and colloidal systems (soft matter) with specific functionalities available and identify their foundations in their atomic structures. In addition, they are studying biological macromolecules, biological membranes, subcellular components, and whole organisms.

RESEARCH GOAL

To use large-scale facilities and continue development of their instrumentation in order to examine crystalline and non-crystalline samples.

EXPERTISE

Synthesis of complex structures, X-ray crystallography, electron microscopy, ex-situ, in-situ, in-vitro, and in-vivo structural and functional characterisation.

RESEARCH FACILITY

- **BESSY II:** X-ray microscopy and microspectroscopy, macromolecular X-ray crystallography (MX), photoelectron and X-ray spectroscopy (LiXedrom/Liquidrom), ASAXS
- **BER II:** SANS

Helmholtz Partners
DESY / FZJ / GSI / HZG / KIT / VI "Multifunctional Biomaterials for Medicine"

HZB Organisational Units
F-ISFM / F-NFF

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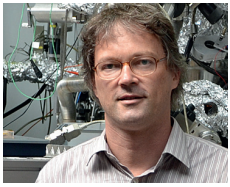
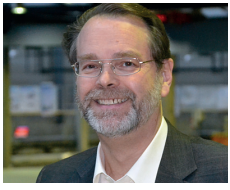


RESEARCH THEME:
Quantum Condensed Matter: Magnetism, Superconductivity, and beyond
HZB-coordinator:
apl. Prof. Dr. Oliver Rader

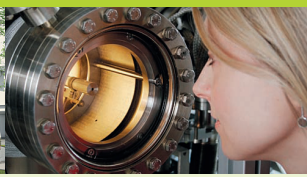
RESEARCH THEME:
Materials and Processes for Energy and Transport Technologies
HZB-coordinator:
Prof. Dr. Alexander Föhlisch



RESEARCH THEME:
Nanoscience and Materials for Information Technologies
HZB-coordinator:
Prof. Dr. Alexei Erko

RESEARCH THEME:
Soft Matter, Health and Life Sciences
HZB-coordinator:
Dr. Manfred Weiss





HELMHOLTZ PROGRAMMES / HELMHOLTZ-PROGRAMME:

RENEWABLE ENERGIES (RE) / ERNEUERBARE ENERGIEN (EE)

TOPICS:

- **Solar Cells of the Next Generation** / Solarzellen der nächsten Generation
- **Solar Fuels** / Solare Brennstoffe

ENERGY EFFICIENCY, MATERIALS AND RESOURCES (EMR) / ENERGIEEFFIZIENZ, MATERIALIEN UND RESSOURCEN (EMR)

TOPIC:

- **Methods and Concepts for Material Development** / Methoden und Konzepte für die Materialentwicklung

STORAGE AND CROSS-LINKED INFRASTRUCTURES (SCI) / SPEICHER UND VERNETZTE INFRASTRUKTUREN (SVI)

TOPIC:

- **Electrochemical Storage** / Elektrochemische Speicherung

FUTURE INFORMATION TECHNOLOGY (FIT)

QP: Forschungsbereiche Energie und Schlüsseltechnologien / CCP: Research Fields Energy and Key Technologies

TOPICS:

- **Controlling Spin-based Phenomena** / Steuerung Spin-basierter Phänomene
- **Controlling Collective States** / Steuerung kollektiver Zustände

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM

RENEWABLE ENERGIES (RE)

The “Renewable Energy” Progamme (RE) is one of seven programmes in the comprehensive Helmholtz research area of “Energy”. The Helmholtz centres conduct research into technological areas with which solar energy, wind power, bio-mass, and geothermal energy can be converted into flexible, usable forms of energy, such as electrical power and combustible gas. The mission: develop a means of utilising renewable energy sources more efficiently, flexibly, and sustainably. These sources can only deliver dependable baseline power jointly, so ways must be found to make them synergistic and complementary.
HZB participates in two of the six research topics: “next-generation solar cells” to more efficiently convert sunlight into electrical energy by developing material systems including thin-film piles as well as 3D micro- and nanotopologies, and the creation of storable fuels with the help of solar energy, referred to as “solar fuels.” The activities of the technologically oriented RE Programme are closely tied to the Energy, Materials, and Resources Programme (EMR).

PARTICIPATING CENTRES: DLR / FZJ / GFZ / HZB / KIT / UFZ
SPOKESPERSON: Prof. Dr. Bernd Rech, HZB

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM

ENERGY EFFICIENCY, MATERIALS AND RESOURCES (EMR)

Five Helmholtz centres are advancing their established expertise in characterising energy-related materials through the EMR programme. A key strength of this programme will be the employment of each centre's major research facility. Since energy-related materials as a rule are exposed to extreme conditions, such as temperature fluctuations or corrosive gases for example, researchers want to identify processes in materials that limit their operating life or influence their efficiency. HZB research is focussing on material systems made up of thin-film composites or three-dimensional composite material architectures that efficiently convert solar energy into usable forms of energy. New developments in the "Renewable Energies" Programme (RE), such as nanocomposites based on nanowires for example, will be characterised here using correlation analysis. The new EMIL Energy Materials in-situ preparation and analysis Laboratory will become a key research facility in this effort.

PARTICIPATING CENTRES: DLR / FZJ / HZB / HZDR / KIT
SPOKESPERSON: Prof. Dr. Manfred Aigner, DLR

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM

STORAGE AND CROSS-LINKED INFRASTRUCTURES (SCI)

This programme, which is integrated in both the EE and EMR programmes, focusses on technical means of energy storage and distribution. The goal is to minimise future power fluctuations caused by energy generation/consumption imbalances while continuing to develop transmission infrastructure to allow different energy carriers to be interconnected. Different energy storage solutions are being investigated for this purpose. HZB is involved in one of six topics addressing development of electrochemical storage solutions through to the application stage. Acknowledging the need for both stationary and mobile energy storage, the focus is on materials for use in electrodes as well as on electrolytes.

PARTICIPATING CENTRES: DLR / FZJ / HZB / HZDR / KIT / UFZ
SPOKESPERSON: Prof. Dr. Mathias Noe, KIT

HELMHOLTZ PROGRAMME / HELMHOLTZ-PROGRAMM

FUTURE INFORMATION TECHNOLOGY (FIT)

CCP: Research Fields “Energy” and “Key Technologies”

During the last decade new classes of materials have been discovered that may become components for future information technologies. These materials allow faster and more energy efficient information processing and storage. Quantum effects are the key to understanding their physical behavior and figure prominently in this research.

HZB is involved with two of four topics: “Controlling Spin-based Phenomena” and “Controlling Collective States.” The aim of this research is to shed light on electronic phenomena like spontaneous order in crystal and spin lattices. Our aim is to make it possible to use the magnetic properties of electrons in information processing, storage, and transmission. BESSY II is ideally suited to studying these processes in the femtosecond range.

PARTICIPATING CENTRES: FZJ / HZB
SPOKESPERSON: Prof. Dr. Rainer Waser, FZJ

HELMHOLTZ PROGRAMME: RENEWABLE ENERGIES (RE)

TOPIC:

SOLAR CELLS OF THE NEXT GENERATION / LK I

Thanks to global progress in research, photovoltaic systems will become increasingly efficient and their contribution to the global supply of energy will continue to rise, according to predictions by experts. The next goal of PV research is to further increase the efficiency and operating life of solar cells and to design and develop more cost-effective and sustainable production processes. Research at HZB is focussed on thin-film technologies and three-dimensional nanocomposite material topologies. Silicon, semiconducting compounds, and organic/inorganic hybrid structures are the base materials for this. Cost-effective, broad-coverage nanostructure technologies are being developed using top-down etching processes and shadow masks integrated with bottom-up self-organising processes. An additional object of research is to produce innovative electrode materials.

RESEARCH GOAL

To create the prerequisites for a broad spectrum of innovations and thereby reduce the dependence PV has on a single technology.

EXPERTISE

Synthesis and optimisation of materials, comprehensive analytical capability, development of solar cell designs and realisation of beta samples, implementation of the technological basis for the manufacture of modules.

RESEARCH FACILITY

- **BESSY II:** EMIL
- **PVcomB**

Helmholtz Partner
FZJ

HZB Organisational Units
E-IS / E-IH / E-IT / E-IP / E-IN / E-GMS / E-NOPT / E-NSIP

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HELMHOLTZ PROGRAMME: RENEWABLE ENERGIES (RE)

TOPIC:

SOLAR FUELS / LK I

Within this topic, the centres are working on different routes to produce chemical fuels with sunlight, such as thermochemical, photoelectrochemical, and biological routes. Efforts at HZB focus on the photoelectrochemical route, using competences and synergies in the area of thin film photovoltaics and catalysis. Hybrid photovoltaic / photoelectrochemical devices are being developed that can split water into hydrogen and oxygen using sunlight. This requires new materials that combine efficient light absorption with high catalytic activity and excellent chemical stability.

RESEARCH GOAL

Development of materials and device technologies for economically viable production of solar fuels.

EXPERTISE

Preparation tools: e.g. PVD, (PE)CVD, ALD, sputtering, advanced analytics, electrochemistry, solid state chemistry of absorber and catalyst materials.

RESEARCH FACILITY

- **BESSY II:** EMIL
- **PVcomB**

Helmholtz Partners
DLR / HI ERN / UFZ / HNSEI
Strategic Partners
JCAP (Joint Center for Artificial Photosynthesis) at CALTECH / NREL / Light2Hydrogen Programme of the BMBF

HZB Organisational Units
F-NFF / E-IF / HI-ERN

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HELMHOLTZ PROGRAMME: ENERGY EFFICIENCY, MATERIALS AND RESOURCES (EMR)

TOPIC:

METHODS AND CONCEPTS FOR MATERIAL DEVELOPMENT / LK I

Energy materials have to be able to withstand extreme stresses and perform their function both reliably and as efficiently as possible over extended periods of time. Sophisticated atomic-scale simulations and measuring processes are essential for producing new kinds of materials with the desired properties. HZB experts are studying physical processes that limit the efficiency and stability of solar cells, key photocatalytic compounds, and materials for thermoelectric energy generation. The new EMIL facility at BESSY II (scheduled startup 2015) will allow observation of thin film growth without breaking the vacuum. This way, these key components will be able to be developed more quickly.

RESEARCH GOAL

To develop new kinds of solar materials and coating systems.

EXPERTISE

Comprehensive analytics, including EPR spectroscopy in the MHz to THz ranges (both in the lab and at BESSY II).

RESEARCH FACILITY

- **BESSY II:** EMIL, EPR
- **BER II:** Neutron scattering and tomography

Helmholtz Partners
DLR / FZJ
Strategic Partners
FH Mülheim / Max Planck Society

HZB Organisational Units
F-IAM / F-AME / M-AKR / G-ARSN / E-IS / E-IN / E-NI

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HELMHOLTZ PROGRAMME: STORAGE AND CROSS-LINKED INFRASTRUCTURES (SCI)

TOPIC:

ELECTROCHEMICAL STORAGE / LK I

Central to this topic are battery systems like lithium ion batteries as well as new systems that are still at the proof-of-concept stage of development. The HZB's focus is on metal sulfur battery systems that are considered promising technologies, in spite of the fact that their observed performance is still far from what is theoretically possible in terms of performance and energy density. Also, the number of potential charge cycles is still far too small.

RESEARCH GOAL

To understand the relationships between the atomic and mesoscopic structure of the materials used and the lithium sulfur system's efficiency in order to get this battery concept to the application stage.

EXPERTISE

Analysis using neutron scattering, electrochemical impedence spectroscopy / in-situ XTM based characterisation.

RESEARCH FACILITY

- **EMIL:** preparation and analysis laboratory with SISSY and CAT lab complexes
- **BER II:** neutron scattering and diffraction, time-of-flight spectroscopy
- **BESSY II:** in-situ X-ray microscopy

Helmholtz Partners
DLR / FZJ / HI ERN / HZDR / KIT
Strategic Partner
MPI für Kolloid- und Grenzflächenforschung

HZB Organisational Unit
F-ISFM

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HELMHOLTZ CROSS-CUTTING PROGRAMME: FUTURE INFORMATION TECHNOLOGY (FIT)

TOPIC:

CONTROLLING SPIN-BASED PHENOMENA / LK I

Topological insulators, nanomagnetic systems, multiferroic materials, or spin structures all possess electronic and magnetic properties that may prove useful in the design of new devices. HZB researchers are analysing these properties and shedding light on spin-based phenomena at high spatial and temporal resolutions. The relevant processes, like domain wall shifts and magnetic excitations, are all taking place in the nanosecond to femtosecond time scale.

RESEARCH GOAL

Analysis of electronic and magnetic properties and interactions within the materials and at interfaces, as well as the identification of parameters to control them.

EXPERTISE

Use of interconnected and complementary experimental stations and methods closely linked with sample growth and characterisation.

RESEARCH FACILITY

- **BESSY II:** ARPES and Spin-ARPES, PEEM, high field XMCD, FEMTOSPEX

Helmholtz Partners
FZJ / VI "New states of matter and their excitations" / VI "Dynamic Pathways in Multidimensional Landscapes" / Helmholtz Russia Joint Research Group "Topological Surface States under the Influence of the Exchange Interaction"

HZB Organisational Units
M-AMD / G-ISRR

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HELMHOLTZ CROSS-CUTTING PROGRAMME: FUTURE INFORMATION TECHNOLOGY (FIT)

TOPIC:

CONTROLLING COLLECTIVE STATES / LK I

In this topic, researchers are investigating collective states in condensed matter, such as quantum magnetism, superconductivity, and ferroelectricity. These phenomena of spontaneous order in crystal and spin lattices, with their special properties such as quantum coherence or unusual quasiparticles, have potential for IT and energy technologies.
HZB researchers are investigating phase transitions, sometimes under extreme conditions, and new classes of materials such as multiferroic systems and unconventional superconductors, in order to understand the ordering phenomena on the atomic scale. Particularly systems with low order and high entropy promise interesting new properties.

RESEARCH GOAL

To control such states and phase transitions and to adapt them for future applications.

EXPERTISE

Crystal growth, electron microscopy, atomic force microscopy.

RESEARCH FACILITY

- **BER II:** Inelastic neutron scattering
- **BESSY II:** ARPES and X-ray scattering

Helmholtz Partners
FZJ /
VI "New States of Matter and their Excitations"

HZB Organisational Units
M-ICMM / M-AQM / G-ARSN

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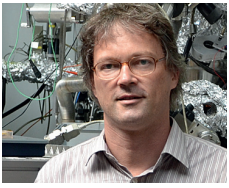
Programme speaker:
Prof. Dr. Bernd Rech

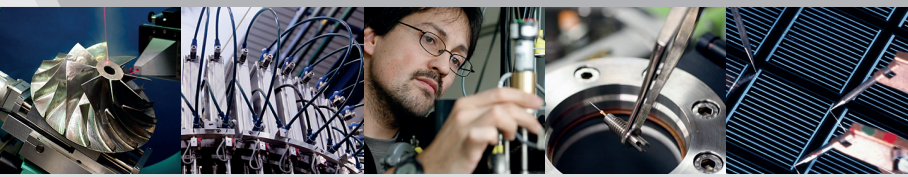
TOPIC:
SOLAR CELLS OF THE NEXT GENERATION
Deputy topic speaker:
PD Dr. Silke Christiansen

TOPIC:
SOLAR FUELS
Topic speaker:
Prof. Dr. Roel van de Krol



TOPIC:
CONTROLLING SPIN-BASED PHENOMENA
HZB-coordinator:
apl. Prof. Dr. Oliver Rader

TOPIC:
CONTROLLING COLLECTIVE STATES
Topic speaker:
Prof. Dr. Bella Lake



List of Abbreviations / Abkürzungsverzeichnis

Strategic Expansion Investments / Strategische Ausbauinvestitionen

Portfolio Process / Portfolioprozess

Performance Categories (LK I and LK II) /
Leistungskategorien (LK I und LK II)

Associated Programme Involvement / **Strategic Partners** /
Assoziierte Programmbeteiligungen / Strategische Partner

Cross-Sectional Activities / Querschnittsaktivitäten

From Application to Evaluation / Von Antragstellung bis Begutachtung

LIST OF ABBREVIATIONS

PARTNERS IN THE HELMHOLTZ COMMUNITY

DESY	German Electron Synchrotron
DLR	German Aerospace Centre
FZJ	Jülich Research Centre
GFZ	Helmholtz Centre Potsdam – German Research Centre for Geosciences
HI ERN	Helmholtz Institute Erlangen-Nürnberg for Renewable Energy
HNSEI	Helmholtz-NREL Solar Energy Initiative
HZG	Helmholtz Centre Geesthacht for Materials and Coastal Research
HZDR	Helmholtz-Zentrum Dresden-Rossendorf
HZI	Helmholtz Centre for Infection Research
KIT	Karlsruhe Institute of Technology
PVcomB	Competence Centre Thin-Film- and Nanotechnology for Photovoltaics Berlin
UFZ	Helmholtz Centre for Environmental Research – UFZ
VI	Virtual Institute

EXTERNAL PARTNERS

PTB	National Metrology Institute providing Scientific and Technical Services
MPG	Max Planck Society
BAM	Federal Institute for Materials Research and Testing

RESEARCH FACILITIES AT HZB

BeJEL	Berlin Joint Electron Paramagnetic Resonance Laboratory
B*ERL*inPro	Energy Recovery Linac (Prototype)
BESSY^{VSR}	Concept for Variable Pulse-length Storage at BESSY II
CAT-Labor	Laboratory for Catalysis Research at EMIL, operated by the Max Planck Society's Fritz Haber Institute/Max Planck Institute for Chemical Energy Conversion
EMIL	Energy Materials In-situ Laboratory Berlin: Preparation and analysis laboratory with lab complexes SISSY and CAT
EXED	Extreme Environment Diffractometer at neutron source BER II
HFM	High Field Magnet
NEAT	Time-of-flight Spectrometer at Neutron Source BER II
SISSY	Laboratory for In-situ Spectroscopy for Solar Materials at the synchrotron

POF III

CCP	Cross Cutting Programme
CPA	Cross Programme Activities
CPI	Cross Programme Initiative

STRATEGIC EXPANSION INVESTMENTS

Similar to the →portfolio process and →cross-sectional activities, strategic expansion investments are used by the Helmholtz Association as a tool for strategic research planning. These strategic investment projects' associated costs total a minimum of 15 million Euros. At the HZB, the project B*ERL*inPro has received funding for a five-year-period since the beginning of POF II in 2010 as a strategic expansion investment. Together, the Helmholtz Association, the federal government, the State of Berlin, and the HZB have invested a total of 25 million Euros.

Beginning in 2015, the new BESSY II concept (BESSY^{VSR}, Variable Pulse-length Storage Ring) will be incorporated as a strategic expansion investment into the Helmholtz Association's dedicated process. In the future, BESSY^{VSR} will allow researchers to set up the desired pulse length for each individual experiment at each beamline.

To qualify for funding, strategic expansion investments must be deemed worthy by each of the Helmholtz Association's six research areas. Applications for funding must be outside of programme-oriented funding and evaluated with involvement of all the different Helmholtz committees. In the end, it's the Helmholtz senate, which, as the Helmholtz Association's highest governing body, makes the final call.

PORTFOLIO PROCESS

During a single funding period, new research questions may be identified and receive special funding as part of the portfolio and foresight process that has been in place since 2010. In doing so, the Helmholtz Association is pursuing its goal of strengthening its profile and charting new research territory.

All submitted topics are assessed by a team of HZB and external experts within the six research fields and, so long as they are considered to hold some potential, are granted start-up funding. If the research is viewed in a positive light, the portfolio topic falls under regular Programme-Oriented Funding.

As such, as of 2011, accelerator research within the research field “Matter” is being funded as part of the portfolio process. Through 2014, the Helmholtz Association is committed to investing 16.7 million Euros in the portfolio topic “Accelerator Research and Development” (ARD). Beginning in 2015, with the start of POF III, the portfolio topic, which five other Helmholtz centres, two Helmholtz institutes, eleven universities, two Max Planck institutes, and the Max Born Institute are all working on together, will be covered by Programme-Oriented Funding for “Accelerator Research and Development” as part of the “Matter and Technologies” (MaT) programme.

PERFORMANCE CATEGORIES (LK I AND LK II)

Within the different programmes, the Helmholtz centres are pooling their research and development activities and are working on finding answers to their own scientific questions. Research activities make up part of the Helmholtz in-house research and are assigned to performance category I (LK I). By contrast, operation of large-scale scientific facilities falls in its own category, LK II, so long as they:

- are used by over 50 percent of scientists from outside the Helmholtz Association,
- select their users/projects using a transparent protocol and so long as the selection committee also consists of members who are not part of the Helmholtz Association,
- result in annual operating costs (absorbed cost basis) of at least 5 million Euros.

Both BER II and BESSY II are part of performance category II. All research activities assigned to a particular topic are basically assigned to performance category I.

Financing and evaluation of programmes and topics are separated by performance category and according to different sets of standards (→From application to evaluation).

For all LK II topics, the absorbed cost basis for the next five years (staff, operations, cost of materials, etc. including overhead expenses) was assigned to funding period POF III as were the amounts that are projected to be incurred over the course of the next five years through rising staff or energy expenditures. As part of the evaluation process, funding of the facilities is checked for plausibility.

LK I topics are also given baseline funding as soon as they register for the new funding period. Additional financial funding is only possible if a topic has received a positive evaluation after an application has been filed.

ASSOCIATED PROGRAMME INVOLVEMENT / STRATEGIC PARTNERS

In the third Programme-Oriented Funding period, the Helmholtz centres are, for the first time ever, identifying associated programme involvement. All partner institutions – whether they are part of the Helmholtz Association or external partners – are contributing their own funding to the different programmes.

The term “associated programme involvement” describes collaborations that are integral to a programme’s or topic’s scientific scope. All partners within a given programme are pursuing a common strategy. As part of the programme “Energy Efficiency, Materials and Resources” (EMR), the Max Planck Society’s Fritz Haber Institute and the Max Planck Institute for Chemical Energy Conversion are considered programme associates as they operate the EMIL CAT lab (as part of BESSY II), although BESSY II or BER II could also be considered programme associates. Such is the case for the programme “From Matter to Materials and Life” (MML). Associated programme involvement contributes the involved partner’s own staff to the programmes and claims their own publications as documentation of their research.

What’s more is that a strategic partnership mirrors an existing long-term collaboration. Strategic partners of the HZB include, for example, the National Metrology Institute (PTB), with whom the HZB jointly operates the Metrology Light Storage Ring.

Both terms – strategic partners and associated programme involvement – are used to describe and categorise different forms of collaborations with partners within and outside of the Helmholtz Association.

CROSS-SECTIONAL ACTIVITIES

In an effort to cross-link centres across research fields and work on common questions, the Helmholtz Association has implemented a new system of cross-sectional activities. Depending on the cross-linking, Cross Programme Activities (CPA) are the weakest type of link while Cross Programme Initiatives (CPI) and Cross Cutting Programmes (CCP) are on a par with other programmes that are part of Programme-Oriented Funding (POF).

For Cross Programme Activities, it is imperative to document how the HZB is cross-linked throughout the Helmholtz research fields and how it is sharing infrastructures. “Structural Biology” is one CPA that is part of POF III, where the HZB is working with the Helmholtz centres within the research field “Health” (HZI Braunschweig, Helmholtz Center Munich). Cross-Programme Activities need their own concept, their own coordinators and spokespersons; funding and evaluation, however, are provided by the respective programmes.

By contrast, Cross Programme Initiatives must provide and document their own funding. In POF III, the HZB will be a part of the CPI “Technology and Medicine – Adaptive Systems”. Centres from the research fields “Health”, “Matter”, and “Key Technologies” have teamed up in order to co-develop imaging methods for a more in-depth study of biomaterials and their interactions within the body.

“Future Information Technology” (FIT) is one of the Cross Cutting Programmes in funding period III. It links the Helmholtz research fields “Key Technologies” and “Energy.” Like every other programme, it receives separate funding, is evaluated separately, and has its own spokesperson. Both research fields are actively involved with the funding process.

Just like →Portfolio topics or →Strategic expansion investments, the cross-sectional activities system is used by the Helmholtz Association as a tool for guiding the planning and continual adjustment of research.

FROM APPLICATION TO EVALUATION

Programme-Oriented Funding (POF) follows a five-year cycle. POF III will start in January 2015 and end in 2019. Preparations began back in 2012 with the ratification of research policy requirements by the federal and state governments as financial sponsors, in an active dialog with the Helmholtz Association. In parallel, the Helmholtz research fields “Energy” and “Matter” drew up the necessary strategic planning of research emphases and programme structures: Where are we at now? What are some of the challenges we’re facing? How do we go about addressing these challenges?

The actual starting signal came during the second half of 2012, when the HZB registered the full cost plan of its BESSY II and BER II facilities, which, during the first half of 2013, was followed by binding registration of all programme participants and associated costs. The applications for →performance categories I (LK I) and II (LK II) were filled out between April and October 2013 and filed on November 1, 2013.

The evaluation is scheduled for January 2014. Through April, the programmes are evaluated by international evaluators summoned by the Helmholtz Association’s senate commission. Their evaluation will ultimately determine whether or not additional funding beyond the basic funding measures is granted. A positive evaluation could result in a 0.2 percent growth to approximately 2.5 percent.

A different set of standards applies to evaluation in the performance categories. In LK I, programmes and topics are appraised from a scientific strategic perspective; by contrast, in LK II, they are checking to see if funding is even plausible. On top of all that, a separate evaluations committee will be visiting the HZB to take a tour of BESSY II and BER II in order to evaluate user services.

By the fall of 2014, at the end of the application and evaluation process, the Helmholtz Association senate will be making a funding recommendation. January 2015 will mark the beginning of POF III.

In 2017, halfway through POF III, a midterm evaluation will be performed. The following year, in 2018, the HZB will start to get ready for the next funding period. In 2019, a new evaluation phase follows the application phase before the January 2020 start of POF IV.

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MASTHEAD

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